Icing prediction on blade wind turbine using forecast data

From Antoine Amossé, instrumentation and control Engineer
Summary

1. Context & Challenge
2. Data integration and algorithm
3. Results
4. Conclusion & Further development
5. Nergica
Context

Icing accretion
Context

Icing ➔
- Risks for H&S
- Fatigue on structure
- Power loss
Context

Coating

Electrothermal

Hot air

Solution!!
Challenge

Forecast Data -> PI Node/Svr -> Model/Algorithm -> Notifications -> Action
Forecast data
- Forecast models:
  - NAM
    North American Model
    +3.5 days
  - HRDPS
    High Resolution Deterministic Prediction System
    +2 days

PRIVATE
PUBLIC
Forecast data

Updates ~6h

Station 1
Station 2
Station 3
Integration in PI Server

- Data is imported into PI using Universal File Loader (UFL) interface
Building structure in PI AF

Build an AF Structure to facilitate deployment of analysis and algorithms through multiple sites.
Visualization in PI

Now

Future

NERGICA
Building algorithm

ICING = LOW TEMP. + WATER
Building algorithm

ICING = LOW TEMP. + WATER

Low Temp.

Icing

Water
Building algorithm

Validation in PI AF
Ice measurement

SN ELEC Wind Farm

- Date/Time: 26/01/2018 14:00:00
- Net power: 3,910.3 kW
- Reactive power: 13,113 kW
- Voltage L-L: 25.656 kV
- Mtly kWh Delivered: 125,443 kWh
- Mtly kWh demand: 845 kWh

SN ELEC Microgrid

- Date/Time: 26/01/2018 14:00:00
- Net power: -1,937.3 kW
- Renewable Energy: 17.68 kW
- Voltage L-L: 613.37 V
- Prod/Cons status: IDLE
- Monthly Energy: 2,126,650 kWh
- Daily Energy: 123.51 kWh

WEC001
- 9.3 m/s
- 1,641 kW
- Prod

WEC002
- 12.3 m/s
- 1,961 kW
- Prod

WEC003
- Calc Failed m/s
- -0.47 kW
- Disc

WEC004
- 7.8 m/s
- 15.33 kW
- Prod

PV0001
- 280.1 W/m2
- 3.64 kW
- Prod

Building
- -15.0 °C
- 15.7 kW
- IDLE

NERGICA

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Ice measurement
Data comparison

- Picture Analysis
- Icing prediction
Data comparison

Picture analysis VS Icing algorithm

Accumulation (mm)

Picture analysis  Icing prediction Accumulation

Visualization in PI Vision
Alerting customer

Edit the trigger

Choose user/groups

Manage format
Conclusion

• Alerts are sent 12h and 1h before event to users

• Challenges
  • Data available periodically
  • Building and optimize algorithm

• PI system allows to
  • Deployment
  • Archiving & validation
  • Review the events
Future work

• Optimization of algorithms
• Analysis of benefits in $$ or operation time
• Microgrid management based on forecast data
  • Renewable production (Wind, solar)
  • Storage management (battery, flywheel)
• Load estimation
Nergica

Centre of Applied research that stimulate innovation in the renewable energy
Wind Energy Conference

Carleton-sur-Mer, QC, CANADA
Thank You

Optional: Click to add a takeaway you wish the audience to leave with.
Conference Theme & Keywords

- Icing
- Wind Turbine
- Ice pellets
- AF structure
- Blade
- Solar energy
- Precipitation
- Image Analysis
- Notification
- Forecast
- Nergica
- PI Analytics
- NAM
- HRDPS
- Nergica
- Canada
- Weather
- Prediction
- Wind Energy
- In-site measurement
- Matlab
- Freezing rain
- Solar Energy
- Snow
- PI_UFL
- Icing sensors
- Camera system
- Québec
## Icing prediction for blade wind turbine using forecast data

### NERGICA

Nergica éolien is a center of expertise that supports the development of the wind industry through research, technology transfer and technical assistance for businesses.

<table>
<thead>
<tr>
<th>CHALLENGE</th>
<th>SOLUTION</th>
<th>RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deicing systems installed on wind turbine blades need to be activated prior the meteorological event, in order to prevent icing accretion.</td>
<td>Algorithm based on forecast data are built to detect the beginning of the icing event.</td>
<td>Activating heating system in wind turbine keep the blade hot and avoid ice accretion, up to a given rate</td>
</tr>
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<td>• Integration of forecast data</td>
<td></td>
<td>Algorithms are compared with in-site instrumentations</td>
</tr>
<tr>
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<td></td>
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- Algorithms are compared with in-site instrumentations
- Benefits have not been measure yet
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Questions

Please wait for the microphone before asking your questions

State your name & company

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